MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2022/2023 (TERM ID 2215)

TMA1401 – MATHEMATICS FOR INFORMATION SYSTEMS I

(All sections / Groups)

22 FEBRUARY 2023
9.00 a.m. – 11.00 a.m.
(2 Hours)

INSTRUCTION TO STUDENT

1. This question paper consists of 4 printed pages (inclusive of the front page) with 4 questions only. Page 4 is the appendix for the logical equivalence laws.
2. Attempt **ALL FOUR** questions. The distribution of the marks for each question is given.
3. Please print all your answers in the Answer Booklet provided.
4. Show **ALL** of your working steps clearly.

QUESTION 1 [TOTAL: 10 MARKS]

a) Let $A=\{1,2,3,5,6,10,15,30\}$ and $B=\{2,3,5,7,11,13\}$. Find

i) $A-B$ [1 mark]

ii) $B-A$ [1 mark]

iii) $A\Delta B$ [1 mark]

iv) $P(A-B)$ [1 mark]

b) Given R be relation on set $A=\{1,2,3\}$ that

$$R=\{(1,1),(1,2),(2,1),(2,2),(3,1),(3,3)\}$$

i) Is R reflexive? Justify your answer. [1 mark]

ii) Is R symmetric? Justify your answer. [1 mark]

iii) Is R antisymmetric? Justify your answer. [1 mark]

iv) Is R transitive? Justify your answer. [1 mark]

c) Let $R=\{(x,y)\,|\,x>2y\}$ be the relation on the set of integers.

i) List at least 2 elements of R. [1 mark]

ii) Is R a function? Justify your answer. [1 mark]

QUESTION 2 [TOTAL: 10 MARKS]

a) Consider the vector $\mathbf{a}=\langle -5,3,7\rangle$ and vector $\mathbf{b}=\langle 6,-8,2\rangle$.

i) Find $\mathbf{a}\cdot\mathbf{b}$. [1 mark]

ii) Determine the angle θ in degree between $\mathbf{a}$ and $\mathbf{b}$. [3 marks]

b) Consider the following matrix A:

$$A=\begin{bmatrix}-5 & 2\\ 2 & -2\end{bmatrix}$$

i) Find the eigenvalues for the matrix A. [2 marks]

ii) For each eigenvalue obtained in (i), find its eigenvector. [4 marks]

Continued ...

QUESTION 3 **[TOTAL: 10 MARKS]**

a) Use equivalence laws to show that $(p \wedge q) \rightarrow (r \wedge q)$ and $p \rightarrow \neg q \vee r$ are logically equivalent. [5 marks]

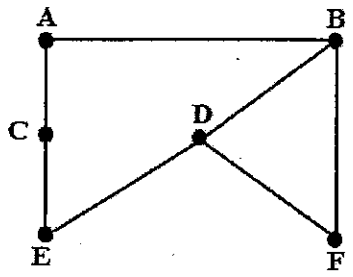
b) Use mathematical induction to show that

$$4^3 + 4^4 + 4^5 + ... + 4^n = \frac{4^{n+1} - 4^3}{3} \text{ for all integers } n \geq 3.$$

[5 marks]

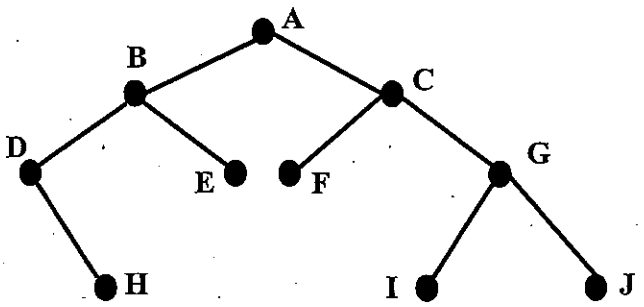
QUESTION 4 **[TOTAL: 10 MARKS]**

a) Given the following graph:



Use the **breadth first search** algorithm to find a spanning tree for the above graph. Take vertex ***C*** as the root and apply alphabetical order if there is more than one choice in the path. Show clearly each step of how the algorithm is performed and present your answer in a table with three columns, the first column is the number of steps, the second column is the stack for the search algorithm and the third column is the edges of the resulting spanning tree. [6 marks]

b) Find the visitation order for the tree below using **in-order** traversal.



[2 marks]

c) How many friends must Alice have to guarantee at least FIVE of them will have birthdays in the same month? [2 marks]

Appendix

List of Logical Equivalence Laws

Conversion of Implication: $p \rightarrow q \Leftrightarrow \neg p \vee q$

Conversion of Equivalence: $p \leftrightarrow q \Leftrightarrow (p \rightarrow q) \wedge (q \rightarrow p)$

Double Negation: $\neg\neg p \Leftrightarrow p$

DeMorgan	:	(i)	$\neg (p \wedge q) \Leftrightarrow (\neg p \vee \neg q)$		
		(ii)	$\neg (p \vee q) \Leftrightarrow (\neg p \wedge \neg q)$		
Domination	:	(i)	$p \wedge F \Leftrightarrow F$	(ii)	$p \vee T \Leftrightarrow T$
Negation	:	(i)	$p \wedge \neg p \Leftrightarrow F$	(ii)	$p \vee \neg p \Leftrightarrow T$
Identity	:	(i)	$p \wedge T \Leftrightarrow p$	(ii)	$p \vee F \Leftrightarrow p$
Commutative	:	(i)	$p \wedge q \Leftrightarrow q \wedge p$	(ii)	$p \vee q \Leftrightarrow q \vee p$
Idempotent	:	(i)	$p \vee p \Leftrightarrow p$	(ii)	$p \wedge p \Leftrightarrow p$
Distributive	:	(i)	$p \wedge (q \vee r) \Leftrightarrow (p \wedge q) \vee (p \wedge r)$		
		(ii)	$p \vee (q \wedge r) \Leftrightarrow (p \vee q) \wedge (p \vee r)$		
Associative	:	(i)	$p \vee (q \vee r) \Leftrightarrow (p \vee q) \vee r \Leftrightarrow p \vee q \vee r$		
		(ii)	$p \wedge (q \wedge r) \Leftrightarrow (p \wedge q) \wedge r \Leftrightarrow p \wedge q \wedge r$		
Absorption	:	(i)	$p \vee (p \wedge q) \Leftrightarrow p$		
		(ii)	$p \wedge (p \vee q) \Leftrightarrow p$		

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